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WHAT SCIENCE REQUIRES OF THE NEW WORLD[1]

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Fellow Americans:

PERMIT me to say a word first to the members and affiliates of the American Association for the Advancement of Science, whose number approaches a million.

Once more, because of the rigors of war, we have found it impossible to hold the annual meeting that has been our tradition for almost a century. My own colleagues, as typical members of our association, are this afternoon in their laboratories, engaged as devotedly as any member of the armed forces in the effort to preserve our country's freedom. Yet the world comes to us as representatives of science with searching questions. We must pause to give a considered answer. "This is a war of science and technology," they tell us. "Do the forces of freedom have the knowledge, skill and technical resources needed to bring victory?" "After the war is over how will science have changed our world?" The nation asks us, "What of the night, and what of the day that is to dawn?"

Unconditional answers to these questions can not be given. Yet it is possible to say something about the present balance of scientific power and to point the direction in which science makes it necessary for the world to move.

I have accordingly chosen as my subject for to-day, "What Science Requires of the New World." For science is not only a servant; it also gives orders. There is a legend that Daedalus, the Greek hero who first learned how to work with steel, toiled long and hard with his forge and anvil to fashion a sword. This he presented to King Minas to replace his old one made of bronze. The citizens of Crete came to him in consternation. "This sword will not bring us happiness," they complained, "it will bring us strife."

[1] Address of the retiring president of the American Association for the Advancement of Science, January 1, 1944.

"It is not my purpose to make you happy," replied Daedalus. "I will make you great."

Science is the steel of Daedalus. His sword is the weapons we are fashioning with the aid of science. As his steel, so likewise science brings new social conflicts and changes in treasured traditions. But also like the steel of Daedalus, science is compelling man to follow the sure road to a greater destiny. Let us try to catch a glimpse of this new world that science bids us enter. Can we attain a stable peace? In the post-war world, what changes in our mode of life does science demand?

First, let us note that science affords real hope for a stable peace. We find ourselves in a world conflict with the mighty powers of science strengthening the arms of both contestants. "A hundred physicists in this war are worth a million soldiers." This oft-quoted statement was made by one of our leaders early in the struggle. Consideration of the military significance of radio, magnetic mines, methods of submarine detection and a variety of new weapons which the physicists have initiated or developed indicates that this estimate may not be greatly exaggerated. With equal justification, however, one might have singled out the vital contributions to the war effort made by research in chemistry, mathematics, immunology, aerodynamics or some other field of science and technology. We have learned that knowledge is strength, and that intensive scientific research is the only way of supplying certain types of knowledge that are essential to waging modern war.

The fact is that science and technology are now spending extraordinary efforts on supplying means of destruction and methods of protection against attack. At first it was our enemies who had the scientific advantage. This was because for a prolonged period the Axis powers had been making extensive scientific as well as military preparations for the war. There is evidence, however, that in most fields of military operations our technical advances are now coming more rapidly than are the enemy's. When added to our overall industrial advantage and our superiority in supply of materials and men, if this scientific advantage can also be maintained, there is little room for doubt of the success of our armies.

We do not discount our opponent's strength. We know the high quality and resourcefulness of his scientific and technical men. We accordingly expect reverses as well as successes. Yet the Allied Nations are in a superior position with regard not only to availability of materials, industrial capacity and numbers of fighting men, but also with regard to scientific and technical strength. Because we have this strength, and are determined to preserve our freedom, we may lay our plans for the future on the assumption of victory.

When peace has then been won, can the world be kept stable?

Let us assume that the United Nations have gained a complete victory. All indications are that the world will still be actively war-minded. However successful may be our armies and the efforts of the negotiators of peace, a great conflict such as the present war will leave many wrongs unrighted and large groups of people resentful at their fate and filled with fear and hatred toward their neighbors. Weapons of destruction are being developed of hitherto unheard-of power. No one can consider the armadas of mighty bombers, with flying range to reach any target, and the increasing amount of destructive bombs they carry, without fear of a yet more disastrous war to come. There will be a nation smarting under the restrictions placed upon it and ambitious for power. What will prevent it from welding these weapons into a war machine with which it will snatch the mastery of the world?

The only answer to this threat is preparedness and vigilance by the powers in control. Preparedness and vigilance have always been the price of continued peace. What science and technology have brought into the picture is a change in the type of precautions that must be taken. Improving the chance for stable peace is the increasing time and magnitude of the preparations required to wage successfully a modern war.

Consider what is needed to exploit the power of airplanes. Here is a weapon whose development and production strains the technical resources of the greatest nation. The same is true of the factories that would build tanks or the laboratories that would develop electronic devices superior to those of an ingenious and highly skilled enemy. It is one of the great safeguards of the stability of modern society that the weapons with which wars are now won are the product of cooperative research and manufacture on so large a scale that the effort can not be hid. If precautions to maintain peace are to be taken, we must assume the establishment of a world policing system with power to learn what nations are doing that may constitute hazards to the public safety, and determination to stop unlicensed building or accumulation of arms. The large scale of modern military preparations makes such policing much more practicable than was true before technology became the basis of military power.

But, we are asked, can not some new weapon be developed secretly on a small scale which is nevertheless so powerful that those who hold it will have the world at their mercy?

Here again the trends of modern science give us considerable assurance. More and more the major inventions and industrial developments are the result of the cooperative efforts of large groups of research

men. An idea may emerge in the mind of a lone inventor, but it passes through many hands before it is ready for use. Also, parallel developments by competing groups are the rule. It is rare indeed that a completed new industrial development catches the world by surprise. If this is true in industry, it is yet more unlikely that the balance of the world's military power will be upset by an idea kept secret from a vigilant enemy. To be of conclusive military significance not only must the idea be perfected; the new weapon must also be adapted to industrial production and be manufactured on a major scale. But such a development is difficult to hide. In spite of airplanes and radios, the world is still a big place, and a weapon that would conquer the world must be ready for widespread use. If we are alert we should know of any new military development of this kind before it has become a hazard to nations organized to protect the public safety.

One of the most necessary aspects of vigilance is the active cultivation of science. Not only is science the foundation for present military developments; it is also the means of opening up of new possibilities. It is an absolute "must" for a nation that would maintain its place in a warlike world that it shall keep its science in the front rank. The possibilities of present and new ideas of military import must be explored to be sure no competing nation will gain the advantage of being first in the field. Only by maintaining an active body of scientists can the foundation be laid for a strong military structure when it is required. Stability and peace in the new world thus can not be ensured unless the dominant world power keeps up a vigorous and continued growth of science.

Equally essential to military superiority is industrial strength, factories accustomed to doing large tasks rapidly, sources of raw materials and good communications. These are the tools that will make effective use of the ideas developed in the laboratories. Possession of large armies, navies and air forces are needed to start a war, but if the struggle is prolonged mere accumulation of such forces can not bring victory. Ultimate fighting power depends rather upon knowledge and facilities for building this knowledge rapidly into weapons as best fitted to changing conditions. Careful attention must thus be given to both the scientific and the technological foundation of military might.

The net result is that with the use of a world police force of a feasible size, it should be possible for a dominant governing body to maintain a stable peace in the new world that science builds. In spite of mighty new weapons that may tempt some ambitious leader to try again to snatch control of the world, the need for vast scientific and technical development to produce such weapons gives a stability adequate for a vigilant governing power to keep the peace.

So much for the *negative* side. We have seen that in the world that science is shaping an alert government should be able to prevent serious wars if only it will maintain the strong science and technology that are the basis of modern military strength. What now of the *positive* side?

Scientific men are becoming increasingly conscious of their social responsibilities. They begin to realize more clearly the tremendous human implications of the forces which their investigations are introducing. A parent is eager that his child shall contribute something worthwhile to society. So the scientist is eager that his science shall work for human welfare. He sees vast new possibilities for betterment of life, and he is impatient to see these possibilities become realities. More and more those concerned with science are endeavoring to ensure the wise use of the products of science.

But I am not concerned to-day with what we as members of the American Association for the Advancement of Science may *want* our sciences to do for humanity. I would call attention rather to those changes in society which growing science and technology make inevitable. I am not referring to new gadgets or improved standards of living, nor even to better health and longer life. These are the obvious and direct results of applied science. We know they will come as science continues its task, and they are welcome gifts, indeed. But I am thinking rather of the inescapable trends that follow the principles of evolution. Only those features of society can survive which adapt men to life under the conditions of growing science and technology.

There are three such features which I shall use as examples. These are (1) increasing cooperation, (2) better and more widespread training and education, and (3) rise of commonly accepted objectives toward which society will strive. Note that such changes mean growth to greater manhood. That science makes them inevitable was what Daedalus meant when he said his steel would make men great.

Finding ourselves then in a stable new world, how will the conditions of life be changed?

Perhaps the most significant change in the life built by science and technology will be the increased organization of people into larger groups concerned with performing common tasks. People will become yet more specialized, and consequently will be increasingly dependent upon each other.

H. G. Wells has called attention to a remarkable example of evolution, in which during the short period of a thousand generations an organism has been observed to change from an individualistic animal like a

cat to a social animal like a bee or ant. He refers, of course, to man, who twenty-five thousand years ago lived in caves with his loosely bound family, and now lives in vast communities in which each works for the group and depends upon the other for most of his means of living. Here is evolution in progress—social evolution, if you please—man becoming civilized.

My present interest in this process is that the chief forces bringing about the socialization of mankind have always been those of increasing knowledge and techniques, of which the characteristic present-day representatives are science and technology. For thousands of years each village has had its butcher and baker and candlestick maker, specialists in their trades who supply others with their wares. The scientific age has greatly increased this specialization. It is not enough now to be a chemist or an engineer; one becomes an organic chemist specializing on long chain esters, or an electrical engineer specializing on echoes of short electric waves. The nation needs this special knowledge, and supports the few who have it by the efforts of millions of others. In fact, the world itself is not too large a unit to support and use effectively the work of such specialists.

Were it not for technology, by which the work of each person is greatly multiplied through use of power machines and methods of mass production, the work of many highly specialized individuals could not be supported. Were it not for science, which has made possible such developments as steam engines, airplanes and the radio, there would be no markets of continental extent which absorb technology's mass production. Combining the specialization of science and the mass production of technology, a society is built of unparalleled richness and strength.

A noteworthy feature of this modern society is that its strength depends to an unprecedented extent upon the cooperation of its members. Since the specialist can live only through the help of others, cooperation is the corollary of specialization. We have learned that the automobile demands sobriety, and that congested life in a city requires careful attention to sanitation. Similarly, we are now learning that life in the world built by science and technology is possible only with widespread cooperation.

In the fight for survival by various forms of society one sees the evolutionary process operating in full force. During times of stress weaker societies are absorbed or replaced by stronger ones. Cooperation thus becomes essential to the survival of any social régime.

Effective means of securing cooperation accordingly becomes a major objective of political systems. Breakdown of cooperation in the ranks of the enemy becomes a most useful method of weakening an enemy in wartime. Replacing a monarchy with a democracy, introducing the military rule of fascist dictators, rallying a nation to support of a communistic state, all are examples of attempts to secure a more effective basis for cooperation in the common tasks of society.

The first essential in securing widespread cooperation is to develop a widespread desire of people to work together. Several methods of securing such will to cooperate are effective. The most certain is to present people with a common danger, such as attack by an enemy. It is this that has built a nation out of the Chinese people, and that has made the strength of our nation grow beyond our dreams during the present conflict. Another powerful method is to present the group with an inspiring objective. Thus Hitler calls to the Germans to make of themselves a master race, Lincoln challenges his countrymen to strive "that freedom shall not perish from the earth." With such an ideal men and women lose themselves in working for the common cause.

But also in the more prosaic periods of normal, peaceful life the cooperativeness of a community depends upon having common interests. If specialized science requires cooperation, cooperation in a society of free people requires the will to work for the common welfare. "Without vision the people perish" applies with tenfold force to the modern world. Whether this vision comes from the loyalty bred of a common danger, from political or economic expedience, from philosophical principles or from the inspiration of religious teaching, the will must be there. Otherwise the inhabitants of a specialized community can not obtain their needs without conflict, and the great advantages of technological society have turned into tragic liabilities. Science thus requires of the new world that its people shall want to work together for the common good.

Let us note further that the extent of the social unit in which this cooperation occurs is being increased rapidly by science. Typical of the forces working in the direction of expansion is the radio. Its music, stories and news are heard over large areas. The radio advertisements make possible the sale of products over a market of continental size. As a result the optimum size of a strong political or economic unit is rapidly growing. Eighty years ago our country was almost split asunder by divided interests. Now its continental size gives great advantages in both industry and government, and the divisive forces are lost amid the concern with mutual trade and the technical and military strength that comes because the country is big. Science itself is as extensive in its interests as the human race. So also is religion. Nations may try to make themselves

self-sufficient, but this is in the interest of security as opposed to an advantageous economy. Economic considerations alone would make trade extend freely throughout the globe.

The advantages of such global extensiveness are evident in the British empire, and to lesser extent in our own country. A phone call to a distant city brings at once the information needed to complete a design. Tools for an emergency repair are flown across the continent. An international misunderstanding is quickly cleared by flying a statesman ten thousand miles across the sea. Pictures and stories and songs representing the life of one people become familiar to all the world. Such are the forces with which science is drawing the world together into one great community. The fate of the world from here on is a common fate.

It is the American men and women of science who are pioneers in shaping this world community. In no other part of the world is life so dependent upon the products of science as among ourselves. This is clearly demonstrable in terms of the number of kilowatts or of radios or of tons of steel or gallons of gas or telephones per capita. People in other parts of the world look with dread to the time when their lives will be altered by technology. It will upset their ancient customs. Things long cherished will disappear and be replaced by things new and strange. We do not dread science and technology; it is natural to us as a part of our lives. Of necessity the world must look to America as the pioneer in finding how to live a satisfying life in a society based on science.

Amid the standardized products of mass production, how are the ultimate values of individual life to be attained? How can we best cultivate the spirit of mutual helpfulness so highly important for a satisfactory life in a technological régime? What type of education will fit citizens for a useful and satisfying life in such a world? We in America face these questions first and in their most acute form. We who represent American science are those who have perhaps had most first-hand experience in hunting for the answers. The world looks to us to point the way.

One thing we have already found is that technology and science place unprecedented value on education. The use of steam and electric power has decreased the need for common labor, while growing specialization has increased the need for those who coordinate our activities. Skilled labor, however, remains vital to American society for building and operating our machines, and is rewarded with shortened hours and higher pay. Business requires middlemen to handle its varied commerce. Vastly increased numbers of professional men and women have been absorbed in occupations of responsibility which before the era of technology were hardly known. Here we find the engineer, the secretary, the economist, the patent lawyer, the research scientist and many others. Those responsible for planning the work of society have never been so driven by ceaseless demands as in today's America. Reflections of this pressure are to be seen in the multiplication of governmental offices, in the rise of schools of business and public administration and in the growth of the army's staff of supervising officers. The masters of society have indeed become the servants of all, in an unresting labor that knows no release. By emphasizing the need for intelligent direction, and reducing the need for unskilled labor, technology is thus spurring Americans of all levels toward an ever higher standard of training and education.

Most significant, however, of the factors that make life worth while is the vision of a goal that one recognizes as worthy of his supreme effort. Now in wartime Americans find that goal in the victory that will preserve our freedom. When peace comes, what will be the objective that will unite our efforts? Will we be inspired by the new possibilities presented by science for making the world suitable for the highest needs of man? Here is a challenge of a millennium that science presents to religion. For is it not the great task of religion to show us the goals for which we should strive?

But whether we call it religion or humanism or social expediency, acceptable objectives must and will be found. This follows again from the fact that the will to cooperation needs a challenging purpose, and cooperation is essential to the survival of a social system. If we fail to develop adequate objectives our society will be replaced by another that has such objectives. It was Hitler's call to the youth of Germany to lose themselves in the greatness of the German Volk that gave such strength to what had been a sick nation. It was Lenin's challenge of a great new society based on equality of all and the glory of work for the common welfare that has made of modern Russia a mighty power. To Americans the values inherent in freedom had been almost forgotten. We were weak from lack of objective, until the Japanese attack united us to meet a common danger.

Perhaps the great objective for us will be that of the common welfare, as discovered by a hundred million citizens who become educated to the possibilities of common men. Leaders we have, and new ones must arise, who will give us the inspiration of great ideals.

As scientists, it is our primary task to give our country the strong foundation of science necessary for her proper growth. If we can also find for ourselves the way to useful and satisfying citizenship in the society built on that foundation of science, the world will follow our leadership.

To Daedalus, steel was much more than metal for

fashioning swords. It was the means of making men grow to greatness. So likewise science.

We have in science a powerful weapon with which to fight our war for freedom. If the powers in control will be vigilant and will establish a suitable policing system, science and technology are giving us a world in which a stable peace can probably be maintained. But science requires changes in our mode of life. The specialization of our society based on science must be matched by ever closer cooperation on a rapidly increasing scale. Growing attention to special training and more extensive education for leadership is inevitable. Such developments give promise of a truly great society. We are, however, in need of the inspiration of a commonly accepted social objective that will unite our willing efforts.

Never has man had so real an opportunity to master his own destiny. With the new ideas of science, the new tools of technology and the new view of man's place in nature that science has opened, we see ever more clearly how we can shape our world. May God grant us a vision of the possibilities of man which will challenge us to the worthy use of these great new powers.

OBITUARY

HERMON CAREY BUMPUS

May 5, 1862–June 21, 1943

THE long full life of Hermon Carey Bumpus was brought to its close on June 21, 1943, at Pasadena, Calif., the home of his elder son. He is survived by his widow, the former Ella Nightingale, and two sons, Dr. Hermon Carey Bumpus, Jr., and Dr. Laurin Dudley Bumpus.

Dr. Bumpus was bred and educated in New England traditions. He was born in Buckfield, Maine, and reared in Dorchester and Boston. His father was a much beloved Boston city missionary—an unordained pastor, his mother a woman of marked ability and vision, a former teacher.

Nature endowed him with exceptional charm of appearance, and manner, with dynamic, tireless energy and exuberant vitality that lasted well beyond the scriptural allotment of years.

He had a clear mind, wide intellectual interests and an exceedingly lively creative imagination which he relied upon, rather than upon tradition, habit or counsel to direct his course of action. This explains his proverbially direct and original approach to a problem. His own predilection for things which can actually be seen accounts for his confidence in the effectiveness of laboratory work in contrast with the lecture as a means of teaching and for the fact that his really great contribution to education in America must be attributed mainly to his genius for ocular demonstration in the laboratory, the museum and under the open sky.

His instinctive desire to point out to other people what had been discovered took on serious and ever-increasing importance. It inspired his teaching and, when he became responsible for the uses to which great educational resources both in materials and in scholarship were to be put, it became to him a prime moral obligation.

To Dr. Bumpus the mental habits and traits of human beings were important natural phenomena to be accepted and dealt with realistically and sympathetically; this attitude added a fine touch to the quality of his teaching, his museum work and his administration. As a teacher, he was inspiring and simply unforgettable. His methods were original, usually unorthodox, but always effective. His aim was to inspire and orient; it was never indoctrination. His advanced students and his junior colleagues still remember with gratitude how he kindled their enthusiasm and constantly encouraged and generously commended their individual initiative. He was a constant advocate of purposeful research in both the theoretical and the practical fields and he himself worked with equal enthusiasm in either field. As an administrator, Dr. Bumpus was singularly free from a desire for power, personal credit or substantial reward. His heart's desire was to "see things go." He was generous in giving credit to others for the success of mutual undertakings and in assuming blame when things went wrong; yet, when occasion required, he would fight to the last with ardor and enthusiasm for what he considered a matter of principle.

After Dr. Bumpus was graduated from Brown University in 1884, he spent two years there as assistant in zoology, taught zoology at Olivet College for three years, went as fellow to Clark University in 1889, and was the first recipient of a degree from Clark, a Ph.D. He returned to Brown to teach biology in 1890, and during his ten years at Brown he continued his very active teaching, organizing and administrative work at the Marine Biological Laboratory at Woods Hole until 1895. Later, at the U. S. Fish Commission, as scientific director, he restored the scientific features envisioned by its founder, Spencer F. Baird. Then followed ten years at the American Museum of Natural History, of which he became the first director, three years at the University of Wisconsin as the first business manager and five years as president of Tufts College. From 1924 until 1940 he was engaged in

organizing the educational program in the National Parks and concurrently he served for five years as consulting director of the Buffalo Museum of Science.

Dr. Bumpus played an important part in establishing or remodeling the policies and practices of several of these institutions. He also, as an active trustee, impressed his unmistakable hallmark upon many others.

It is not derogating from his accomplishments elsewhere to say that his most important work was done in the field of his primary interests, biology and natural history, and that it was at Brown University and concurrently at Woods Hole, at the American Museum of Natural History and in the National Parks that his creative and administrative talents found their greatest opportunity.

At the age of twenty-eight he deliberately set out to establish at Brown a department, in effect a biological institute, within the university which should combine the collegiate traditions of undergraduate teaching with the ideals of research which he had found at Clark University and which in turn were obviously derived from European universities of the seventies and eighties, via the Johns Hopkins. He proposed to introduce also the element of familiar companionship prevalent at Woods Hole, inherited from Agassiz's earlier laboratory at Penikese. Before his decade at Brown was over he had realized his vision in all essential respects. This demonstration of what collegiate education might be, which was novel fifty years ago, strongly influenced the development of the educational policy of the university.

In 1901, at the invitation of President Morris K. Jesup, Dr. Bumpus began his service at the American Museum of Natural History under conditions which contrasted sharply with those which he dealt with at Brown. The museum was a great institution, having already an amazing wealth of material, equipment and financial resources, both actual and potential. He entered the field, "when museums of nearly every type were just thawing out of their Ice Age." The thawing process was considerably accelerated both at the American Museum and throughout the country by his strenuous and eminently successful efforts in developing the educational functions of this museum and in founding the American Association of Museums (1905–06).

In the museum field, as in his university work, Dr. Bumpus held that both research and teaching were necessary for discharging the obligation of the institution as a whole to those in whose interest it was founded and maintained and that it is the responsibility of the administrator to see that these obligations are met. His old associates at the museum attest his staunch adherence to this proposition in his administration. A distinguished colleague has said: "Bumpus' cardinal principle in the conduct of his office was cooperation. He made it a point to form an almost daily contact with the head of each department, scientific, clerical and mechanical, and the breadth of his knowledge permitted him to meet each man on his own ground, and there was created a spirit of promptness and effectiveness that was diffused throughout the museum." The increasing confidence placed in him by President Jesup resulted in a "combination of authority and ability under the impetus of which the potentialities of the museum developed rapidly, and in *research, exhibition* and *education* it took its place among the leading institutions in its field."[1] After a change in the organization of the museum had substantially affected the authority which had gradually been vested in the office of director, and the official attitude of the museum toward popular education, Dr. Bumpus left the museum and, temporarily, the field of natural history to become a pioneer in the new field of university business management at the University of Wisconsin. After three years of signal success in this office, he was called to Tufts College as its president and successfully guided the college through the strenuous war years. In 1919 he left it with its prestige enhanced and its foundations strengthened.

In 1924 Dr. Bumpus returned to the field of natural history to take a leading part in organizing a nationwide educational program in the National Parks. The purpose of this program was to point out and interpret the primeval, archeological and ethnological features of the parks to the increasing throngs of visitors and to provide the only reliable insurance for the preservation of a priceless national heritage by creating an intelligent interest born of understanding in the minds of the millions of voters who ultimately control its destiny.[2]

The desirability of such a program developed out of the earlier separate efforts of several enthusiastic park executives under the stimulus and support of certain influential citizens who visited the parks and became concerned over the immense unimproved opportunities for public enlightenment which they afforded. With the approval of the National Parks Service and supported by liberal grants from the Laura Spelman Rockefeller Memorial, the American Association of Museums undertook to implement this program. Dr. Bumpus, as chairman of its committee on outdoor education, was requested to assume leadership. He submitted a highly original plan for plac-

[1] Italics mine.

[2] The chief naturalist, Dr. Carl P. Russell, reports that "during the five-year period 1938–42 the average yearly number of visitors to the areas of the National Park System has been 17,000,000" and that "the great majority of these visitors have made use of the park museums. . . ."

ing at strategic points throughout the National Parks what he called "Trailside Museums" which were to be small museums located in the field. The natural features of the parks were to be the exhibits in situ and undisturbed. The buildings were to contain readily available sources of information and interpretation about them. It was characteristic of him that his solution was simple and direct and that he based his whole program squarely upon the psychology of "Everyman," who is naturally anxious to learn about the new things he sees around him. The function of the museums was to furnish reliable information while he is in this receptive mood. Dr. Bumpus was requested to create a model museum in the Yosemite to serve as a demonstration. This was done with the enthusiastic cooperation of the park executives. The success of this experiment was so complete and the validity of the basic idea so well attested that a succession of "trailsides" was soon established in other national parks, and eventually, as was hoped, the United States National Parks Service took over the program. Dr. Bumpus as National Parks Advisory Board chairman continued to be its guiding spirit. At present there are more than 200 such museums in national, state and municipal parks throughout the country, the offspring of the famous demonstration in the Yosemite. Happily, Dr. Bumpus lived to see his vision realized in the nation-wide adoption of his "Trailside Museum" idea.

When he reached the age of seventy-eight, Dr. Bumpus resigned from active leadership in this National Parks program and, in doing so, deliberately brought to its conclusion the active phase of his long career. In the formal awards of medals and in the documentary references to his life's achievements which followed, he was especially gratified by the acknowledgments of the correctness of his far vision in anticipating the results of the programs which he had projected so long before.

The Department of the Interior in its "Field Manual for Museums" acknowledges that the Manual itself "may well be regarded as evidence that the field museum program anticipated by Dr. Bumpus and his associates of the Committee on Outdoor Education is an established instrument in teaching Americans to know their heritage."

The American Scenic and Historical Preservation Society awarded the Cornelius Amory Pugsley Gold Medal in 1941 to Dr. Bumpus for "his creation and popularization of the trailside museums" and the president in his citation paid him high tribute as a zealous pioneer.

In 1941 the distinguished service award, officially the Henry W. Kent Diploma, presented to him by the American Association of Museums, also brought Dr. Bumpus complete and gratifying assurance that his early vision had been correct. No other body was so competent to judge of the trends in museum development and no person so intimately familiar with the whole range of Dr. Bumpus's museum work as its president, Dr. Clark Wissler, who gave the citation.

Finally in May, 1943, when Dr. Bumpus resigned as Senior Fellow of Brown University, having been a member of the board for nearly forty years, the Corporation abandoned the precedent of a hundred and seventy-five years and promptly elected him the first Fellow Emeritus.

Dr. Bumpus thoroughly enjoyed his stay upon this planet, which he found "so full of a number of things." He enjoyed pointing out these things in a new light to the men, women and children, high and low, who were here in his time, and he did not neglect the interests of those yet to arrive. At the last, he went on his way in a golden sunset aware that what he had done and the motive of it had won approval in the judgment of his peers.

A. D. MEAD

RECENT DEATHS

DR. WILLIAM EMERSON RITTER, professor of zoology at the University of California until his retirement with the title emeritus in 1923, who was from 1909 to 1923 director of the Scripps Institution of Oceanography at La Jolla, died on January 10 at the age of eighty-seven years.

DR. GEORGE OTIS SMITH, from 1907 to 1930 director of the U. S. Geological Survey, chairman of the Federal Power Commission in President Hoover's administration, died on January 10 in his seventy-third year.

DR. JOSEPH JASTROW, professor of psychology at the University of Wisconsin, where he was a member of the faculty from 1888 until his retirement in 1927 with the title emeritus, died on January 8 at the age of eighty years.

DR. CASWELL GRAVE, since 1919 professor of zoology and head of the department at Washington University, St. Louis, who retired with the title emeritus in 1940, died on January 8 in his seventy-third year.

DR. FRANK LEVERETT, formerly lecturer on glacial geology at the University of Michigan, died on November 15 at the age of eighty-four years.

DR. GEORGE A. PFEIFFER, associate professor of mathematics at Columbia University, died on January 4 at the age of fifty-four years.

DR. GEORGE CRANSTON ANDERSON, since 1932 secretary of the British Medical Association, died on January 1 at the age of sixty-four years.

A CORRESPONDENT writes: "Dr. Hans Becker, geologist for Socony-Vacuum Oil Company in Caracas, Venezuela, died in July, while engaged in active field work. Dr. Becker was formerly dozent in the University of Leipzig and professor at the National Central University in Nanking. His many publications dealt chiefly with the regional aspects of stratigraphic and structural geology, to which field he made important contributions. His early death, at a time when much of his work was incomplete, is greatly to be regretted."

SCIENTIFIC EVENTS

THE SCHOOL OF AGRICULTURE OF THE HEBREW UNIVERSITY OF JERUSALEM

THE Hebrew University of Jerusalem will graduate this year the first class of agronomists to be trained in Palestine. As recently as five years ago it was necessary for students who wanted professional training in scientific agriculture either to go abroad or to change their plans. The Hebrew University, in cooperation with the Agricultural Research Station of the Jewish Agency, has provided them with a School of Agriculture of university rank.

Though inaugurated in 1940, the School of Agriculture was formally opened late in 1942, when the senior class was ready for the professional courses in agricultural science, which are given in the new building of the School of Rehovoth. The head both of the School of Agriculture and of the Agricultural Research Station of the Jewish Agency is Professor I. Elazari Volcani. Professor Volcani is known for his pioneer research and experimentation in Palestine and for his long experience in practical farm management.

The five-year curriculum of the school, which is confined for the present to mixed farming as the most wide-spread form of agriculture in Palestine, is divided into three parts: two years' study of physics, chemistry, general soil science, geology, botany, zoology, bacteriology and meteorology at the university. These courses are followed by one year's practical work on the land. The fourth and fifth years are spent in Rehovoth, where the courses include practical as well as theoretical instruction in farm management, special soil science, field and garden crops, horticulture, citriculture, agricultural entomology, plant pathology and animal husbandry.

The two years' course in natural sciences at the university is also directly bound up—and not only theoretically—with the future professional work of the students. Their teachers are men and women who have long applied their researches to the practical problems of agriculture in Palestine and helped the settlers out of many a difficulty with the results of their experimentation.

The students learn how to apply science to agricultural problems in different countries in accordance with the local conditions peculiar to each. An essential fact that applies to these students is that they are at home in Palestine and mean to devote themselves to agriculture there. In view of the important services that they will soon be able to render on the vital home front, all have been excused from the duty of enlistment in the armed forces by the Jewish recruiting committees.

SUGGESTED BRITISH SCHOOL OF AERONAUTICAL SCIENCE

REPLYING to a question raised in the House of Commons on December 1, we learn from *Nature* that the Minister of Aircraft Production, Sir Stafford Cripps, announced that the Aeronautical Research Committee had recommended the creation of a new school of aeronautical science, coordinated with existing training facilities, to bridge what it considers to be a gap in the present system. This report is approved in principle by the government, and an interdepartmental committee has been appointed to prepare detailed proposals for its establishment. The committee is under the chairmanship of Sir Roy Fedden, sometime designer and chief engineer of the engine section of the Bristol Aeroplane Company. This company was one of the first in the aeronautical world to initiate an apprentice training school in its works under Sir Roy's guidance, and in addition he has just returned from a tour of the United States, where he has studied the systems of aeronautical instruction in use there.

Although the terms of the report were not announced, it is said to follow the scheme described by Sir Bennett Melvill Jones, the chairman of the Aeronautical Research Committee, in his remarks at a recent discussion on aeronautical education before the Royal Aeronautical Society. The school will be postgraduate and will be additional to the facilities of a similar standard at present available at universities. It will deal with advanced study and experimental work of a technical nature, leaving the more scientific and research aspects to the university schools. It is also hoped to include certain aspects of flying, incidental to the teaching. It is hoped that such training will appeal to the university graduate who desires to take up the more applied side of the profession, the

works apprentice who has attained a sufficiently high standard in theoretical study, and possibly senior men from the industry and the forces who desire refresher courses.

THE CHICAGO NATURAL HISTORY MUSEUM

THE Chicago Natural History Museum has been officially known by that name only for the past month, since the granting of an amended charter by the Secretary of State at Springfield changed the name of what was formerly Field Museum of Natural History. A statement made by Orr Goodson, acting director, reads in part:

The museum's activities during 1943 continued to be tied in with the war effort. The institution's photographic collections and informational sources were placed at the disposal of the army, navy and other government agencies, and many members of the staff served as consultants on geographic and scientific subjects at the request of government bureaus. Some members of the staff contributed the information for manuals used by soldiers and sailors in far-off lands. For the public, special exhibits pertaining to some of the more important theaters of the war were arranged, and a special series of lectures, "Backgrounds of the War," was presented. To the degree that conditions permitted, all normal museum activities were continued. Attendance was nearly normal, with more than one million visitors received.

The opening of a new hall called "Indian America," devoted to archeology of the New World, was a major event of 1943. This hall represents a radically improved technique in anthropological exhibition methods, characterized by sparsity of labels and brevity of those which are used, the use of especially adapted fluorescent lighting, a liberal use of gay colors, and the inauguration of completely new ideas of exhibition, in which a graphic bird's-eye view of ancient cultures is substituted for large collections of artifacts. Despite shortages of personnel and of materials for construction, many other important new exhibits were installed in all departments of the museum—anthropology, botany, geology and zoology.

The following changes have occurred in the regular staff of the museum: Clifford C. Gregg, director, on leave for service with the army, has been promoted from the rank of lieutenant-colonel to colonel. Dr. C. Martin Wilbur, curator of Chinese archeology and ethnology, has been granted leave of absence to join the staff of the Office of Strategic Services, Washington, D. C. Dr. Julian A. Steyermark, assistant curator of the herbarium, and Llewelyn Williams, curator of economic botany, have been granted leave of absence to engage in foreign missions for the Board of Economic Warfare of the United States Government.

George A. Quimby was confirmed in his appointment as curator of North American archeology; Gustav Oscar Dalstrom was appointed artist in the department of anthropology; Dr. Alfred E. Emerson, Dr. Charles H. Seevers and Alex K. Wyatt were appointed research associates in entomology; Mrs. Roberta Cramer and Miss Emma Neve were appointed lecturers. After a year in service in Africa with the American Field Service, Bert E. Grove, wounded, was returned home, and rejoined the staff as lecturer. Alfred C. Weed, curator of fishes for twenty-two years, retired.

The honor roll of museum employees and trustees now engaged in war services numbers thirty-nine men and women.

THE AMERICAN STANDARDS ASSOCIATION

THE American Standards Association, a federation of national groups dealing with standardization, through which government, industry, labor and the consumer work together to develop mutually satisfactory national standards and which acts as the authoritative channel for international cooperation in standardization work, has announced the publication of a new list of standards. There are more than 600 standards listed, of which 64 have been approved or revised since the last price list was printed in April. The standards cover specifications for materials, methods of tests, dimensions, definitions of technical terms, procedures, etc.

One important phase of the work built up during the twenty-five years that the association has been in existence is in the field of safety engineering. The new list includes ninety-five safety standards. Standards are constantly revised to keep up with advances in industrial methods.

Since the war, the association has been working very closely with government agencies and with the Armed Services to provide specifications for certain of the materials necessary to the war effort. Because these standards are developed through an accelerated procedure, they are designated as American War Standards. These are listed separately, and to date there are forty already completed and many more under development. These war standards have been produced in the field of safety work, machine tools, quality control, photography and radio, just to mention a few. Every government order is based on specifications: standards are used to accelerate production, conserve materials, maintain a balance between quality and price control, simplify inspection, contracting and subcontracting. All are designed to relieve shortages of time, material and man-power.

In each case, the standards approved represent general agreement on the part of maker, seller and user groups as to the best current industrial practice. More than six hundred organizations are taking part in this work.

The complete list of American standards should serve as valuable reference material to engineers, manufacturers, purchasing agents, etc. It will be

sent free of charge to any one interested in the work. Requests should be addressed to the American Standards Association, 29 West 39th St., New York 18, N. Y.

MEETING OF BOTANISTS IN CHICAGO

ACCORDING to a statement received from Dr. Scott V. Eaton, of the University of Chicago, there existed among botanists of the general Chicago region considerable sentiment in favor of holding an informal meeting during the Christmas holidays. Arrangements for such a gathering were made by the departments of botany of Northwestern University and the University of Chicago. The meeting was held at Chicago, on December 29 and 30. Announcements and programs were sent to the departments of botany or biology of the colleges and universities of Illinois, Indiana, Ohio, Michigan, Minnesota, Iowa, Missouri and eastern Nebraska.

Three sessions for the reading of invitation papers were held at the Chicago Academy of Sciences. The facilities provided by the academy were very much appreciated. On the morning of December 29, L. H. Tiffany was chairman of the program, and the speakers included Walter F. Loehwing, the State University of Iowa; Margery C. Carlson, Northwestern University; Neil E. Stevens, University of Illinois; Charles E. Olmsted, the University of Chicago, and O. C. Durham, Abbott Laboratories. The chairman on Thursday morning was Dr. John T. Buchholz, of the University of Illinois, and the speakers were Ralph E. Cleland, Indiana University; Leo R. Tehon, Illinois State Natural History Survey, and Ralph O. Freeland, Northwestern University. At the concluding session on Thursday afternoon John M. Beal, of the University of Chicago, presided, and those who took part were George S. Bryan, the University of Wisconsin; Kenneth E. Damann, Water Purification Division of Chicago, and Wendell R. Mullison, Purdue University.

The attendance at the sessions ranged from forty-five to seventy-four. The lateness of announcing the meeting and travel uncertainties, especially because of the threatened railroad strike, reduced the number of persons present. Also a number wrote that they could not attend because of their war teaching programs.

On Wednesday evening an informal dinner was held at the Webster Hotel with an attendance of fifty-three. Dr. Charles A. Shull, of the University of Chicago, was toastmaster, and after the dinner he called on several persons for brief after-dinner speeches.

The meeting was characterized by good fellowship and friendly visiting. All present seemed very glad of the opportunity of again attending a scientific meeting. It is hoped that even if the war has not yet ended the national officers of the various botanical societies will find it possible to organize meetings, either national or regional, for the next Christmas holidays.

BERMUDA BIOLOGICAL STATION FOR RESEARCH

THE annual meeting of the corporation and a meeting of the trustees of the Bermuda Biological Station for Research, Inc., were held in New York City on December 18.

Officers elected for 1944 were: *President,* Columbus Iselin; *Vice-president,* A. G. Huntsman; *Treasurer,* Ross G. Harrison; *Secretary,* John H. Welsh.

Trustees elected to the class retiring in 1947 were: C. P. Curtis, Jr., P. S. Galtsoff, E. N. Harvey, Columbus Iselin, Stanley Kemp and Daniel Merriman.

The main building and cottages which were leased to the U. S. Army Engineers as a temporary hospital were vacated in June on the completion of the permanent Base Hospital. Dr. Hilary B. Moore, acting as resident custodian, is now occupying the director's cottage and three of the others are rented. Books have been removed from storage and the library has been placed in order.

The former director, Dr. J. F. G. Wheeler, has left Bermuda to take up a new position as fisheries director for the Island of Mauritius. The period of his directorship extended from 1932 to 1941. During this time there were over two hundred investigators who made visits of some length at the station. Eighteen of these were from England, France, Canada and Belgium. There were 138 published contributions covering a wide range of subjects of biological and oceanographic interest. While the main financial support of the station for this period came from income on investments of the original Rockefeller Foundation grant, there was additional support for maintenance and operation from the Bermuda Government of approximately $15,000. During the years 1937–41 the station also received $10,000 through the Royal Society, London, in support of oceanographic investigations. This was in addition to furnishing the research vessel *Culver*.

During the past year there was a net gain of income over expenses amounting to $10,368. Present total assets amount to $304,936. Approximately one third of this is invested in the Bermuda property and the remainder in income-yielding securities.

The location of the station is one of the best in Bermuda in spite of military developments in that region, the buildings are in an excellent state of repair, and the vicinity of Bermuda still remains a uniquely favorable place for investigating the biology, physics and chemistry of the open North Atlantic, especially in deep water. It is the expectation of the trustees that the station will reopen as soon as the progress of the war allows.

SCIENTIFIC NOTES AND NEWS

DR. HARVEY NATHANIEL DAVIS, president of the Stevens Institute of Technology, Hoboken, N. J., and director of the Office of Production Research and Development of the War Production Board, has been elected an honorary member of the Institution of Mechanical Engineers of Great Britain. He is the fourth living American to be so honored. The others are Henry Ford, Professor A. G. Christie, of the Johns Hopkins University, who were elected honorary members in 1939, and Orville Wright, who was elected in 1942. Dr. Davis returned recently from England, where he had been on a government mission for the Office of Production Research and Development and the Combined Production Resources Board of Great Britain, Canada and the United States.

THE Medal of Honor of the Institute of Radio Engineers for service in the field of radio communication has been awarded to Haraden Pratt, vice-president and chief engineer of the Mackay Radio and Telegraph Company and of the Federal Telephone and Radio Corporation, affiliates of the International Telephone and Telegraph Corporation.

SIR GIRLING BALL was appointed Bradshaw Lecturer for the year 1944, at a recent meeting of the council of the Royal College of Surgeons.

DR. M. A. STEWART, associate professor of parasitology at the University of California, has been elected president of the Pacific Coast Entomological Society. Dr. E. Gordon Linsley, assistant professor, has been reelected secretary.

THE American Association for Applied Psychology in September, 1943, authorized the establishment of a Section of Military Psychology. Officers appointed by the Board of Governors are Major T. W. Harrell, AC, office of assistant chief of air staff for personnel, *Chairman;* Lieutenant C. Gilbert Wrenn, U. S. Naval Reserve, Bureau of Naval Personnel, *Secretary.* The present objectives of the section are: (1) to encourage professional relationships among psychologists in the armed services; (2) to provide for the continued availability to the armed services of technical advances in psychology both during and following the war period. Up to January 1, 90 members of the association had joined the section out of about 115 eligible for membership. Of this group of 90, there are 50 serving in Army billets, including the Air Corps, and 40 from the Navy, including the Marine Corps and the Maritime Service.

DR. WALTER B. CANNON, professor emeritus of Harvard University, has been appointed visiting professor of physiology at the New York University College of Medicine.

DR. PHILLIPS FOSTER GREENE, professor of surgery at the Hsiang Ya Medical School, Changsha, China, has been appointed visiting professor of surgery from December 1, 1943, to July 1, 1944, at the Long Island College of Medicine. The appointment was made possible under the terms of a grant from the Commonwealth Fund to encourage the exchange of members of the teaching staff of various medical schools.

DR. LOYAL DURAND, JR., of the department of geography of the University of Wisconsin, has been appointed associate professor in the department of geology and geography of the University of Tennessee. He will take up his new work on February 1.

DR. L. R. WAGER, lecturer in petrology at the University of Reading, England, has been appointed professor of geology at the University of Durham.

DR. JAMES ROWLAND ANGELL, consultant in education for the National Broadcasting Company, formerly president of Yale University, has been appointed to succeed the late Professor William Lyon Phelps as director of the Hall of Fame of New York University.

DR. GUY F. MACLEOD, professor of entomology at the University of California, has been appointed chief of the chemicals and fertilizer branch of the Chemical Division of the War Food Administration.

J. C. MARQUARDT, assistant professor of dairying at the New York State Agricultural Experiment Station at Geneva, has resigned to become assistant director of the division of milk control for the New York State Department of Agriculture.

DR. WILFRED F. HORNER, of the department of biology of Loyola University, Chicago, is now equipping a new biological research laboratory for the Belmont Radio Corporation in Chicago.

DR. ALBERT E. MEDER, JR., professor of mathematics at the New Jersey College for Women, has been appointed secretary of Rutgers University. Dr. Richard Morris has retired as head of the department of mathematics at the New Jersey College for Women.

JAMES E. FENN, chief research chemist of the Gummer Products Company, Troy, Ohio, has resigned his position to join the staff of Johnson, Salisbury, Inc., Consulting Laboratory in New York City.

FRED ERNSBERGER has been reappointed research fellow at the Research Foundation of the Ohio State University. He is working on the cement rehydration project sponsored for the past three years by the Master Builders Company of Cleveland, Ohio.

MRS. ALBERT D. LASKER, of New York, and Dr. George H. Preston, Maryland State Commissioner of

Mental Hygiene, president of the American Orthopsychiatric Association, have been elected members of the board of directors of the National Committee for Mental Hygiene.

DR. CURTIS SAUNDERS, M.R.I.P.H.H., master sergeant, in the Division of Parasitology and Tropical Medicine, Army Medical School, Washington, D. C., has been appointed Captain in the Sanitary Corps, Army of the United States. He will be on duty at the Army Medical School.

AT the Central Laboratories, Hoboken, N. J., of the General Foods Corporation, Dr. Aksel G. Olson succeeds as manager Thomas M. Rector, now vice-president in charge of research and development. Dr. Roland E. Kremers has been appointed director of basic research, with supervision over the sections of organic chemistry and physical research and the newly established section of biochemistry. The following directors have been appointed: Dr. Harry M. Barnes, of the section of organic chemistry; Harvey K. Murer, of the section of biochemistry; Charles W. Kaufman, of the section of processing technology; Dr. Willard L. Roberts, of the section of cereal technology; Hamilton W. Putnam, of the division of cereal chemistry, and Dr. Martha Johnson, of the division of analytical chemistry.

PROFESSOR L. J. WITTS, Nuffield professor of clinical medicine at the University of Oxford, and Professor J. R. Learmonth, surgeon to H.M. Medical Household in Scotland, professor of surgery in the University of Edinburgh and surgeon-in-ordinary of the Edinburgh Royal Infirmary, have been appointed members of the British Medical Research Council.

SIR RICHARD GREGORY, president of the British Association for the Advancement of Science, was recently chairman of a deputation of scientific men to Robert Foot, director-general of the British Broadcasting Company, to ask for better and more frequent scientific broadcasts.

DR. HOWARD T. KARSNER, professor of pathology and director of the Institute of Pathology of the School of Medicine, Western Reserve University, will deliver the eighth Christian Fenger Lecture of the Institute of Medicine of Chicago and the Chicago Pathological Society at the Palmer House on February 14. His subject will be "Calcific Aortic Stenosis."

DR. DETLEV W. BRONK, Johnson professor of biophysics and director of the Eldridge Reeves Johnson Foundation for Medical Physics of the School of Medicine of the University of Pennsylvania, will deliver the second Walter Wile Hamburger Memorial Lecture of the Institute of Medicine of Chicago on January 28. The lecture will be entitled "Cardiovascular Problems in Military Aviation."

PROFESSOR KARL S. VAN DYKE, chief physicist of the Quartz Crystal Section of the Engineering and Technical Service of the Office of the Chief Signal Officer, Army Service Forces, War Department, Washington, D. C., now on leave of absence from Wesleyan University, made an address entitled "Standardization of Quartz Crystal Units" on January 5 before the New York Section of the Institute of Radio Engineers.

DR. JAMES C. MAGEE, Major General, U. S. A. (retired), a former Surgeon General and now director of Medical Informational Service of the National Research Council, recently addressed a special meeting of the staff and students of the Medical Branch of the University of Texas at Galveston, on the significance of tropical diseases before and after the war. The address was sponsored by the Association of American Medical Colleges and the John and Mary R. Markle Foundation.

AT the fifty-seventh annual convention of the Association of Land-Grant Colleges and Universities, held in Chicago in October, the vice-president, C. B. Hutchison, dean of the College of Agriculture of the University of California, was elected president, with C. S. Boucher, of Nebraska, vice-president, and Thomas P. Cooper, of Kentucky, secretary-treasurer. C. A. Dykstra, of Wisconsin, and M. S. Eisenhower, of Kansas, were elected to the executive committee for four-year terms, and W. H. Martin, of the New Jersey Agriculture Experiment Station, was elected to fill the two-year term vacancy created by the death of C. E. Ladd.

THE third annual meeting of the Society of Vertebrate Paleontology, held in the Sinclair Library of Princeton University on December 30, was devoted entirely to business matters and was attended by the officers, C. W. Gilmore, *President;* G. L. Jepsen, *Secretary-treasurer,* and E. H. Colbert, *proxy* for instructed votes. Ten new members were elected.

A WAR production conference for the solution of manufacturing problems, sponsored by the Engineering Societies committee on war production at the request of the War Production Board, was held at the Hotel Commodore, New York City, on January 14. The program was devoted to the interchange of practical ideas and discussion of common problems. There was a dinner in the evening at which Ralph S. Damon, vice-president and general manager of the American Air Lines, Inc., was toastmaster. Captain Eddie Rickenbacker, president and general manager, Eastern Air Lines, Inc., gave an address entitled "Production Responsibilities for 1944." In the afternoon panel meetings were held on the following subjects: chemical industries; metallurgical

problems; transportation; civilian requirements; safety on and off the job and foundry industries and in the evening manpower utilization; welding problems; production and tool engineering; metallurgical problems and foundry industries.

THE *Journal* of the American Medical Association reports that the first Inter-American Congress of Radiology was recently held in Buenos Aires under the presidency of Dr. Jose F. Merlo Gomez. Delegates to the congress resolved (1) to create an Inter-American College of Roentgenology in Buenos Aires, (2) to stimulate the creation of laws in Pan American countries to promote roentgenology and protect roentgenologists and (3) to provide for retirement of roentgenologists if they become victims of the practice of roentgenology. At the close of the congress a monument in honor of Roentgen, Curie and the victims of roentgenology was unveiled in the Instituto Municipal de Radiologia y Fisioterapia of Buenos Aires.

IN its recent report the National Central Library of London, according to *The Publishers Weekly*, records a partial list of the book losses during two years of bombing of the English libraries: National Central Library—105,000 volumes lost, Birmingham Natural History Library—completely destroyed, Coventry Public Library—completely destroyed, Exeter Public Library—almost destroyed, Liverpool Public Library—150,000 volumes lost, Manchester Literary and Philosophical Library—completely destroyed, Plymouth Proprietary Library—completely destroyed, Plymouth Public Library—completely destroyed, University of London Library—many thousand volumes lost, University College Library, London—about 100,000 volumes lost.

DISCUSSION

THE DEMONSTRATION OF TONIC NECK AND LABYRINTHINE REFLEXES AND POSITIVE HELIOTROPIC RESPONSES IN NORMAL HUMAN SUBJECTS

IN decerebrate animals, in newborn infants and in functionally decerebrate or decorticate adult human subjects, rotation or tilting of the head to the side results in extension of the fore and hind limbs of that side and flexion of the limbs of the opposite side. Similarly, backward tilting of the head increases extensor tonus in both fore limbs and diminishes the tonus of the hind limbs. Forward tilting of the head produces opposite results. These phenomena are not ordinarily demonstrable, in clear-cut fashion, in normal adults, but when extensor muscles of the limbs are rendered hypertonic, by the procedures to be described, tonic neck and labyrinthine reflexes are elicited in striking fashion.

If one stands in a narrow doorway and stretches the extensor and abductor muscles of both arms for one to two minutes by exerting strong lateral pressure against the backs of the hands, placed against opposite doorposts, it is found, on standing away and relaxing all voluntary effort, that the arms float toward a horizontal position in a surprising manner. The reflex extensor hypertonus, responsible for the effect of this well-known parlor trick, gradually subsides during a minute or less and the arms fall slowly, or suddenly, to the sides. The mechanism of augmentation of the stretch reflexes, upon which this hypertonus probably depends, has been a subject for speculation.[1] Whatever the mechanism, the increased tone provides a basis for the study of the tonic neck, labyrinthine, eye, crossed extensor, nociceptive and various positive and negative combinations of these reflexes in normal subjects.

[1] A. Schwartz and P. Meyer, *Compt. rend. Soc. Biol.*, 85: 490, 1921.

During "levitation" of the arms, turning or tilting the head to the right, or turning the eyes strongly to the left, or shining a strong light into the eyes from the left increases the abduction of the right arm and diminishes or abolishes tonus in the left arm. The reverse positions of the head or eyes or light cause the left arm to rise again to some degree and the right arm to drop. Forceful downward rotation of the eyes or light from below, or backward tilting of the head increases the tonus and degree of abduction of both arms, while upward rotation of eyes or light from above or ventriflexion of the head reduces tonus in both limbs. A crossed extensor reflex, resulting from strong voluntary flexion of one elbow, facilitates reflex extension on the opposite side. Painful stimulation, as by pinching, quickly abolishes tonus on the affected side. The reflexes mentioned may be combined successively or simultaneously in various patterns of facilitation and inhibition of the extensor tonus.

Temporary hypertonus of the knee extensors results from pushing the toe of one shoe against a wall. The resulting hypertonus may be modified by eye, neck and labyrinthine reflexes, as in a decerebrate animal.

A slight degree of hypertonus of the flexors of the elbow or knee may follow prolonged voluntary contraction of these muscles against resistance. Tonic neck, labyrinthine and eye reflexes produce the ex-

pected alterations, which are, of course, opposite in sign to those affecting extensors of the same joints.

These various studies on postural tonus are best observed by the subject himself, for he alone can be certain that they are involuntary phenomena. However, they have been tried on numerous persons who were not aware of the responses to be expected, and the results, so far, have been concordant.

The evidence for the effects of light on muscle tonus, which has been obtained in the course of these studies, indicates that man possesses latent positive heliotropism. As demonstrated by Garrey[2] for the robber fly, the alterations of tonus are directed in such a way as to assist in turning the body toward the light.

Observations on these reflexes have proved very useful for the teaching of neurophysiology. It is hoped that they may also be of assistance in evaluating the degree of excessive or diminished tone of muscles in neurological examinations or in tests of fitness or fatigue.

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CHOLINESTERASE

IN SCIENCE (November 19, 1943) an attempt has been made by de Laubenfels[1] to claim for Alles and Hawes the priority of our discovery that two distinct cholinesterases exist in the animal body: a specific or true cholinesterase and a non-specific or pseudo-cholinesterase.[2]

Alles and Hawes,[3, 4] to whose work we referred in our first communication,[2] consider the cholinesterase activity of whole blood as due to the activities of a serum and a cell enzyme. This classification is based on a misconception. Experiments reported by us[5] show that the cholinesterase activity of serum is due to the presence of two distinct enzymes, one of which is specific like the enzyme in red blood cells[2] and brain,[6] the other being a non-specific catalyst. Consequently, any statement regarding the properties of the so-called serum enzyme would always refer to the properties of a mixture of these two enzymes. De Laubenfels' assertion that Alles and Hawes, who moreover were unaware of the existence of a specific and a non-specific enzyme, have "thoroughly demonstrated" the existence of the true and pseudo-cholinesterase is therefore invalid.

Regarding de Laubenfels' suggestion that the authors select more suitable names for discriminating between the two enzymes, we feel that the prefix "pseudo" emphasizes the non-specificity of the enzyme to which the name cholinesterase, suggestive of substrate specificity, has hitherto been applied. As we mentioned in the article in SCIENCE, the term "pseudo-cholinesterase" has been provisionally chosen until such time as the physiological function of this enzyme has been determined.

BRUNO MENDEL
HARRY RUDNEY

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APPARENT TIME ACCELERATION WITH AGE

I HAVE read the letters to SCIENCE on the apparent time acceleration with age, and I should like to add a comment that is based on a study of numbers I made several years ago. My thought is that our sensations of elapsed time is strongly influenced by the number of remembered and half-remembmered things that have occurred. Thus at age ten a single day may bring to a boy a number of new events, sensations and thoughts, while at 50 a considerably greater time must elapse before an equal increase is accumulated. These things that fix themselves in our memories are our units of time, and if at 50 a week passes without a remembered event that week is telescoped toward the vanishing point.

An astonishingly large number of natural phenomena are arranged on a logarithmic scale. Thus we may say that an eleven-pound dog is slightly larger than a ten-pound dog, but an 801-pound horse is the same size as an 800-pound animal. Here we would require an 880-pound horse (+10 per cent. as in the case of the dog) before we would admit a perceptible difference. This mode of thought, which sets up a logarithmic scale of measurement, is inherent, I believe, and it has strongly influenced our factual literature, of which memory of past events is a part.

Returning to our sense of elapsed time, I believe that we must add a fixed fraction to our accumulated sense of time before we admit the addition of a new unit, and this makes our elapsed time sense follow the same law that governs our sense of brightness, loudness, weight, etc.

FRANK BENFORD

I HAVE been interested in the discussion of the apparent acceleration of time with the age of the

[2] W. E. Garrey, *Jour. Gen. Physiol.*, 1: 101, 1918.

[1] M. W. de Laubenfels, SCIENCE, 98: 2551, 450, 1943.

[2] B. Mendel and H. Rudney, *Biochem. Jour.*, 37: 1, 59, 1943.

[3] G. A. Alles and R. C. Hawes, *Jour. Biol. Chem.*, 133: 2, 375, 1940.

[4] R. C. Hawes and G. A. Alles, *Jour. Lab. and Clin. Med.*, 26: 5, 845, 1941.

[5] B. Mendel, D. B. Mundell and H. Rudney, *Biochem. Jour.*, 37: 4, 473, 1943.

[6] B. Mendel and H. Rudney, SCIENCE, 98: 2539, 201, 1943.

individual, but I am wondering if we are not really thinking of our present recollection of the passage of time in youth and in later years rather than of the actual feeling of the passage of time that we experienced as it passed. Of course, no individual can compare his own time sense with that of any other individual, younger or older, because such sense is purely subjective and there is no basis of comparison; and it would seem practically impossible, too, for any of us to remember just how fast the days and months seemed to go by at any particular period in his past, so that here again we have no good basis for comparison. We can, however, compare the elapsed time between the remembered events of our past as they now lie in our memories. In my own case the elapsed time between my tenth and my twentieth years, for instance, seems much greater as I look back upon it than that between my fortieth and fiftieth. The reason for this I believe to be that in later years things that happened after we reached maturity seem much nearer *in proportion* than the events of childhood and youth, and this because we feel that they might have happened only yesterday, whereas the youthful happenings belong to another age.

FRANCIS H. ALLEN

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I HAVE read with much interest the papers recently published in SCIENCE as a sequel to a first discussion inaugurated by Frank Wilen some time ago on the "Apparent Time Acceleration with Age." However, I was surprised at the purely psychological treatment of the question and at the fact that all your contributors seemed to think that they were dealing with a new subject. May I remind them that the problem has been thoroughly investigated since 1916, when the first paper on the influence of age on the process of cicatrization was published in the *Journal of Experimental Medicine* (xxiv, 461), then in the *Proceedings* of the American Philosophical Society (1917) and later in the C. R. Ac. Sc., etc. The notion of "physiological time," different from physical time and its method of measurement, were introduced by the writer and discussed by many authors in this country, Professor Hoagland among others. It was fully developed (mathematically and psychologically) in a book published six years ago in New York.[1] Last year, at the April meeting of the American Philosophical Society, the writer presented a paper in which the different aspects of the question were expounded at length. An interesting discussion followed. I feel certain that Messrs. Carlson, Abbott and Harriss will be interested by the odd ten papers and the two or three books dealing exhaustively with this problem in a strictly scientific way, published up till 1936 in the United States, England, France and Germany. The most important references are to be found in the book mentioned below.

P. LECOMTE DU NOÜY

[1] Lecomte du Noüy, "Biological Time," Macmillan, N. Y., 1937.

THE SCIENCE MOBILIZATION BILL

THE letter from Dr. Leland H. Taylor on the Science Mobilization Bill (SCIENCE, November 26) seems to miss the point. He bases his argument on generalities, which are no answer to the specific objections to the specific provisions of the Kilgore bill which its opponents have adduced.

For instance, Dr. Taylor formulates two "pertinent" questions. The first reads, "Does our present organization of science promote the fullest advancement of scientific knowledge?" Since no human institution is perfect, the answer is obviously "No," but how helpful is it in determining whether the specific provisions of the Kilgore bill will accelerate or retard that advancement? Precisely the same comments apply to Dr. Taylor's second question.

Dr. Taylor seems to take at face value certain sweeping charges against industry which have been made in Washington. Does an accusation amount to proof which a scientist should accept? Has Dr. Taylor read the detailed refutation of many of those charges? He complains that only "a few liberal journals of small circulation" (does he so characterize *The New York Times* and *New York Herald Tribune,* which gave full space to those charges?) printed the accusations. The fact is that the charges were given much more space than the subsequent refutations, which may explain why Dr. Taylor missed the latter.

But even if the charges are accepted as proof, the case reads about as follows: Industrial research has resulted in inventions; inventions have been patented; and patents have in a few cases been unfairly used to extend monopoly beyond the bounds of the legitimate restricted monopoly which every patent confers. Therefore research must be reorganized and put under different control. An analogous case would be—research has produced a new and better alloy; that alloy has been used to make better knives; a few individuals have used those knives to commit murder. Therefore we must reorganize metallurgical research and put it under different control. Would it not be more logical to enforce, and strengthen, if need be, the laws against unfair restraint of trade and homicide?

Finally Dr. Taylor makes much of "selfish interest" as the mainspring of present industrial research, and condemns it. Others call it "enlightened self-interest," and praise it. What other motive force would Dr.

Taylor suggest short of compulsion? After all, the two phrases differ essentially only by the word "enlightened." Discussion such as Dr. Taylor's may further enlightenment, but what has it to do with the virtues or faults of the specific provisions of the Kilgore bill?

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SCIENTIFIC BOOKS

MAN

Man Real and Ideal: Observations and Reflections on Man's Nature, Development, and Destiny. By Edwin Grant Conklin. xvii + 247 pp. New York: Charles Scribner's Sons, 1943. $2.50.

In 1921 Charles Scribner's Sons published Professor Conklin's "The Direction of Human Evolution." An important philosophical discussion, this volume was scarcely appreciated because the publishers failed to do anything much in calling it to the attention of scholars. It is sincerely to be hoped that the same fate will not follow the present book. It richly deserves the widest possible distribution and consideration.

As president of the American Philosophical Society, Dr. Conklin is most appropriately filling his position by significant philosophical leadership, at a time when the whole world needs a clear exposition of the philosophical implications of science. Our current philosophers are not very helpful. Few of them understand science. Most of them seem to fear it.

Last year *Fortune* published a series of philosophical articles by such leading American philosophers as Hocking, Sperry, Montague and Maritain, most of whom clung tenaciously to scientifically outmoded positions of intuitionism, mysticism and philosophical idealism. The net impression was that the best to be offered by American philosophy for the future of the world is reliance on wishful thinking and the support of supernatural agencies. It seems to have taken an Englishman to suggest something more worthy of intelligent consideration. *Fortune* was kind in accepting an article from Julian Huxley giving a brief but clear statement of the philosophical implications of modern science. This appeared in December, 1942. It is remarkable that current philosophical problems should after all be important enough for the attention of business men and executives for whom *Fortune* is designed. It is regrettable that the editors of *Fortune* failed to include Conklin in the symposium.

Dr. Conklin agrees with Huxley that the state of our present knowledge of ourselves and our environment leaves little room for hoping that supernatural powers exist to bring us the salvation we crave. Science seems to indicate that responsibility for the future of mankind is on the shoulders of men.

That the implications of our developing verifiable knowledge of ourselves and our environment, as revealed by scientific inquiry, have significant moral consequences is a conclusion reached by many competent biologists. The statements made by C. Judson Herrick (*Sci. Monthly,* 49: 99, 1939) and S. J. Holmes (Science, 90: 117, 1939) agree with those expressed by Conklin. In a remarkable discussion aroused by C. H. Waddington ("Science and Ethics," London, 1942) there is further agreement with the conclusion that our morals are phases of our adaptation to our environment, and thus enable us to develop control of some of our evolutionary progress. It remains to be determined whether or not there is a naturally operative principle regarding human relationships which may have ethical significance. A tentative formulation of such a principle has already been attempted (*Nature,* 141: 783, Dec. 27, 1941).

Dr. Conklin appreciates very clearly what he is doing: "The results of the scientific study of man and philosophical conclusions that are derived from such a study run counter to the inherited traditions and cherished beliefs of multitudes of persons." He is convinced that all phases of human nature are amenable to scientific treatment and must be studied, if studied at all effectively, by scientific methods. These methods consist of careful, systematic, verifiable observations of phenomena, and logical deductions as to their causes, which deductions are then tested by further observations, and, whenever possible, by experiments aimed at isolating various factors or causes. As a biologist, Professor Conklin emphasizes the importance of biological methods in dealing with men. These methods are comparison, analysis, and experiment.

The volume offers a well-organized, comprehensive and brief survey of our present knowledge regarding the human species, tracing the past evolution of man, and discussing paths of progress, natural selection and organic selection as factors in progress, the role of eugenics, and future factors in the evolution of man.

Conklin clearly indicates the conclusions which the biologist must reach on the time-honored mind-body problem—that no distinction is valid. An assumed distinction is as semantically invalid as that between what is considered to be living from that which is thought to be dead.

Dr. Conklin then considers the development of the individual, with discussions of asexual and sexual reproduction, and factors in development, with a careful treatment of mechanisms of differentiation involving cells, chromosomes and genes. In discussing rela-

tions between structure and function Dr. Conklin reveals increasing complexity of organization as more efficient adaptation. Carefully he considers factors in psychic and social development.

The philosophical portion of Dr. Conklin's book deals with the antagonism of science and tradition in which scientific evidence is contrasted with emotional belief. One may infer that Conklin would hold that science sets the limits to belief and faith. He insists on the unity of nature and emphasizes the importance of biological satisfaction in living things. This adaptation for satisfaction becomes the basis for a biological appreciation of value, and for a biological basis for ethics. Ideals are emphasized by Professor Conklin as highly significant if appreciated as goals toward which it may be possible to develop. This offers a basis for a sort of scientific religion.

Of course, the volume must be carefully read in order to appreciate the skill with which Professor Conklin develops his thesis. His achievement is highly artistic and his work is earnestly commended to the sincere study of philosophers, scientists and scholars.

First delivered at Rice Institute, Houston, Texas, in 1941, the lectures comprising this book have already been published in part in the *Rice Institute Pamphlet* (28: 153–281, 1941). It is sincerely to be hoped that Professor Conklin's effort, in relation to many similar attempts by his scientific and philosophical colleagues, may result in a United Nations symposium on science and ethics. Such a symposium might lead to international agreements on articles of a scientific faith that might be very instrumental in helping us to obtain the sort of a peaceful and satisfying world which we all want.

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OPTICAL CRYSTALLOGRAPHY

Optical Crystallography. By ERNEST E. WAHLSTROM, professor of mineralogy, University of Colorado. $5\frac{1}{2} \times 8\frac{1}{2}$ inches. v + 206 pp. 209 figs. New York: John Wiley and Sons, Inc. London: Chapman and Hall, Ltd. 1943. $3.00.

THIS well-designed new text-book is a welcome boon to the students of optical crystallography. The author covers the essential phases of his subject in seventeen short but pithy chapters under the following headings: 1. Crystallography; 2. Physical properties; 3. Elementary optics; 4. The polarizing microscope; 5. Optics of isotropic substances; 6. Measurement of index of refraction; 7. The Uniaxial Indicatrix; 8. Polarization of light; 9. Uniaxial crystals in plane-polarized light; 10. Uniaxial crystals in convergent polarized light; 11. Optical accessories; 12. Sign determination in uniaxial crystals; 13. Biaxial crystals—the triaxial ellipsoid; 14. Biaxial crystals in convergent polarized light; 15. Determination of optical sign in biaxial crystals; 16. Dispersion in biaxial crystals; 17. Microscopic examination of nonopaque substances.

The text contains numerous (209) selected illustrations, including line drawings, half-tone reproductions and stipple-shaded diagrams. Approximately 80 pages of the 206-page book are occupied by illustrations. Diagrams designed to illustrate the three-dimensional visualization of the relationships between crystallographic directions and optical directions are well constructed and will give valuable aid to students who find difficulty in visualizing three-dimensional relationships.

In addition to the author's original material, he has brought together items and illustrations from other good sources and arranged them in a unified order so as to make it easy for the user to get the information he seeks.

His definitions have been carefully written in clear simple language to keep within the understanding of the user. This feature along with others shows the author's recognition of the fact that it is the function of a text-book to inform those who do not know.

In the first half of the book the author reviews briefly the principles of optical crystallographic theories, emphasizing only fundamental ideas; in a few pages discusses the physical properties of crystalline substances, and devotes a short chapter (6 pp., 9 figs.) to elementary optics dealing principally with the nature of light, followed by a well-illustrated chapter on the construction of the polarizing microscope. In the opinion of the reviewer, the chapter describing optical accessories—quartz wedge, gypsum plate, mica plate, etc., recognized as standard equipment—might well follow the chapter on the polarizing microscope.

In the author's discussion of refraction, reflection and the measurement of the indices of refraction (24 pp., 22 figs.), he describes several variations of the immersion method and other methods, using numerous and effective diagrams.

Since immersion media are an invaluable part of the equipment when working with crystal fragments, it will interest the reader to know that a more satisfactory, very inexpensive series of low-index liquids[1] has replaced the alcohols, butyrates and volatile distillates given on page 45. Isopropyl acetate (1.385, very slowly volatile), and diethyl oxalate (1.408) and dibutyl phthalate (1.490), both non-volatile, are miscible in all proportions and are colorless, viscous, odorless, and do not react with mineral grains within that range. The author did not have this information.

[1] These liquids may be purchased from U. S. Industrial Chemicals, Inc., 3200 N. 17th Street, Philadelphia, Pa., for $1.00 per pound.

The last half of the book is devoted largely to the interpretation of optical phenomena exhibited by uniaxial and biaxial crystals in both plane polarized light and in convergent polarized light under a petrographic microscope. By difficultly constructed diagrams and by clear, simplified explanation of optic-axis interference figures, optical signs, dispersion, etc., the author has clarified many points that cause trouble but are not covered in the average text on mineralogy.

To summarize, it is safe to say that this book stands alone in its field. In the opinion of the reviewer it is the most readable and most usable book on the subject of optical crystallography that has yet been produced. It will undoubtedly serve the purpose for which the author designed it—for use in college courses in optical crystallography and optical mineralogy. It will also, no doubt, become an indispensable handbook for all investigators interested in its practical applications in other fields of endeavor.

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SPECIAL ARTICLES

VENEZUELAN-TYPE EQUINE ENCEPHALOMYELITIS VIRUS IN TRINIDAD

VENEZUELAN-TYPE equine encephalomyelitis virus is the agent of a severe equine encephalomyelitis which has been occurring in Colombia[1] since 1935 and in Venezuela[2] since 1936. In 1941 it seems to have invaded also the northern coast of Ecuador.[3]

The corresponding virus has been isolated in Venezuela by Kubes and Ríos in 1938.[4] The comparative immunological studies[5,6] determined this virus as *sui generis,* differing from both the U. S. eastern and western encephalomyelitis strain. Neither has there been found any specific relation to the rabies virus.[7] On the contrary, an immunological identity with the encephalomyelitis virus isolated later in Colombia has been demonstrated.[8]

With regard to Trinidad, this island was considered free from this disease, until this colony's Department of Agriculture[9] announced on October 2, 1943, the first outbreak of it in the southern part of the island, *i.e.,* in the zone opposite the Venezuelan territory. There, 47 cases in all have been diagnosed, 30 in the San Francique Pluck-La Fortune area and 17 in the Debe-Penal area. Eight animals survived the infection.

On October 19, 1943, we received through the courtesy of Major Gilyard from the U. S. Army Veterinary Corps, by this time on the island, two samples of material collected in the infected area some days before: material No. 4 from a horse and material No. 5 from a mule, both in form of brain tissue conserved in a sterile glycerine solution. By intracerebral inoculations of those materials (a 5 per cent. brain-tissue suspension in saline) into white mice and guinea-pigs the presence of a virus has been established in both of them. Material No. 5 has had an especially rich virus content.

The isolated agent showed the same properties as the Venezuelan encephalomyelitis strain in Swiss white mice, guinea-pigs and developing chick-embryos. Swiss white mice, from the second or third passage on, given intracerebrally 0.02 cc of a 10 per cent. brain-tissue suspension in saline, died in from 3 to 5 days. In guinea-pigs inoculated with the same suspension (0.2 cc intracerebrally), the course of the disease was still more rapid. The same suspension dropped on to the chorio-allantoic membrane of eleven-day-old chick-embryos killed them in between fifteen to twenty hours, their bodies showing hemorrhagic infiltrations equal to those produced by the Venezuelan encephalomyelitis virus.

In order to demonstrate the concentration of the virus in the brain-tissue of mice and in the chick-embryos, the titration was started from a 1 per cent. suspension in saline of 7 mouse brains, on the one hand, and of 16 chick-embryos on the other, with a view to eliminating possible individual influences. The titration has been carried out in white mice by the inoculation of 6 of them with 0.02 cc of each tenfold dilution. The mouse brain tissue suspensions were mortal in 100 per cent. from the dilution of 10^{-2} to 10^{-8}. Seventeen per cent. of the mice survived the dilution of 10^{-10}. The embryo-cultured virus suspensions had a dilution endpoint of 10^{-7} that indicates a virus concentration which is considerably lower.

[1] J. E. Albornoz, Suppl. to *Bol. de Agric.,* No. 26: 1, 1935, Bogotá, Colombia. Published by Ministerio de Agricultura y Comercio.

[2] V. Kubes, "La peste loca de las bestias. Sus manifestaciones, tratamiento y prevención." Caracas, Venezuela, 1936. Published by Ministerio de Agricultura y Cría.

[3] Personal communication from Servicio Veterinario Oficial, Guayaquil, Ecuador, 1943.

[4] V. Kubes and F. Ríos, SCIENCE, 90: 20, 1939.

[5] C. E. Beck and R. W. C. Wyckoff, SCIENCE, 88: 530, 1938.

[6] V. Kubes and A. Diamante, *Bol. Inst. Inv. Vet.,* Caracas, 1: 49, 1942.

[7] V. Kubes and F. Gallia, *ibid.*: 81.

[8] V. Kubes, *The Puerto Rico Jour. Pub. Health and Trop. Med.,* June, 1943: 391.

[9] Official statements of the Department of Agriculture, Trinidad, B. W. I., Oct., 1943.

Those results are in perfect accord with the titration of the Venezuelan encephalomyelitis virus, which has in the mouse brain a titre oscillating between 10^{-6} and 10^{-8}, less frequently 10^{-10} to 10^{-12}. In the chick-embryo the average titre corresponds to the dilution 10^{-7} and is rarely higher or lower.

The immunological relation between the recently isolated virus from Trinidad and the Venezuelan encephalomyelitis strain virus (1938) has been studied in the protection test as follows: 72 Swiss mice have been immunized by means of 4 subcutaneous injections of 0.2 cc of the Venezuelan antiencephalomyelitis vaccine from chick-embryo cultured virus, one injection given every other day. The same vaccine has for many years been used with great success in combating encephalomyelitis in Venezuela. Three days after the last vaccination, the animals were divided into two batches for the challenge inoculation: the first group received intracerebrally 6 tenfold dilutions from 10^{-1} to 10^{-6} (using 6 mice for each dilution) of a mouse brain suspension containing Venezuelan encephalomyelitis virus, and the second one equal dilutions of the virus proceeding from Trinidad. Both viruses have been simultaneously titrated intracerebrally in non-immunized mice.

The vaccinated mice showed a solid protection against both viruses on test. The degree of immunity has been more or less equal against both of them, because the mice of each group withstood about 1,000,000 minimal lethal doses.

Summing up our findings, we believe we are entitled to draw the following conclusions:

(1) From 2 studied materials proceeding from a horse and a mule which died in Trinidad with clinical manifestations of encephalomyelitis, a neurotropic virus has been isolated.

(2) Inoculated into mice, guinea-pigs and chick-embryos, this virus showed the same properties as the Venezuelan equine encephalomyelitis strain virus.

(3) The vaccine prepared from Venezuelan chick-embryo cultured virus conferred on mice an equal protection against both viruses, the homologous as that of Trinidad.

(4) Therefore, an immunological identity between those two viruses is suspected.

Work on this theme is being continued.

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AN EXPERIMENTAL TEST OF THE THEORY THAT SOCIAL BEHAVIOR DETERMINES SOCIAL ORGANIZATION

IT appeared to the author that the fighting behavior of male mice of an inbred strain was suitable material for testing a fundamental theory of general sociology —that differences in social organization are caused by differences in social behavior. The strain used was subline 10 of the C–57 black, originally from the Jackson Laboratory at Bar Harbor. These mice have nearly identical heredity and can be depended upon to give similar reactions in similar environments.[1]

Preliminary experiments indicated that the males could be easily trained either to fight or not to fight. It was expected that if two fighting males were placed together they would develop some sort of social control or dominance based on fighting and that this organization would be absent between peaceful mice. This expectation was confirmed in the series of experiments described below, in which the mice were not only from the same inbred strain, but the same individuals were used for both fighting and non-fighting situations.

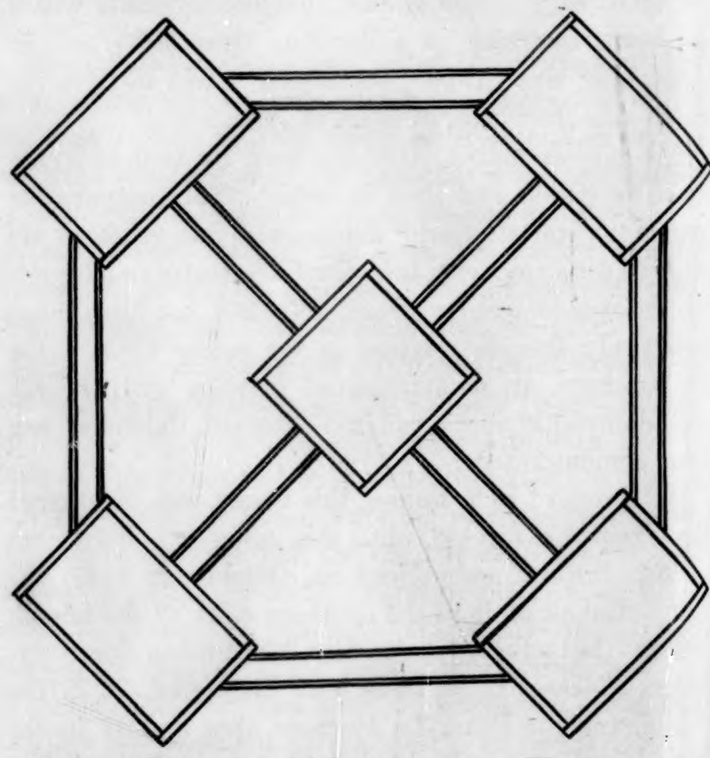

FIG. 1. Plan of multiple escape pen. The corner compartments are the same size as breeding boxes (10 × 15½"), and the entire top is covered with hardware cloth.

The mice were trained not to fight by the following method. A male and female of the same litter were raised in the same pen with no handling after weaning. Young were removed as soon as they appeared. After sexual maturity, as shown by the birth of young, the animals on at least three successive days were lifted out of the pen with forceps, roughly stroked five times and replaced. When another male, similarly trained, was put in the pen, no fight took place. The same result was obtained with each of six different pairs. The peaceful situation lasted as long as observation was continued (up to nine days; longer in

[1] J. P. Scott, *Jour. Heredity*, 33: 11–15, 1942.

preliminary work) without any fighting at the period of observation or any traces of injury at other times.

The apparent explanation is that the males are already inhibited against fighting the females. Since no fighting takes place after handling, they quickly associate not fighting with handling and are inhibited by the latter. There being no fighting at the first meeting, the inhibition probably tends to become permanent.

The same pair of males was then transferred to separate parts of a large multiple escape pen (planned as in Fig. 1) and isolated for at least fourteen days. Following the lead of Ginsburg and Allee,[2] who found that animals fought best if successful in fighting, these males were trained to fight by introducing a belligerent animal of the same strain and removing it before either mouse was hurt. This was done on at least five successive days. Immediately after the last training period the mice were allowed to enter each other's pens, this time without handling. A fight soon started, usually after one male had made a sexual attempt on the other, or had found the path to his home pen blocked. The result was that one of the males soon became the victor and chased the other round and round the two pens. This, a clear case of temporary social dominance based on fighting, was seen with each of the six pairs used.

The development of this organization was watched over a longer period after all other passages in the multiple escape pen were opened; the losing mouse is soon killed if left in the same small area. Each compartment had at least three avenues of escape, and only one mouse was killed while in the large pen. If the mice met while the observer was present, the winning mouse chased the other through the passageways, sometimes making several rounds but finally losing contact. This semi-permanent type of dominance was seen to persist as long as 33 days but gradually tended to die out unless training was repeated from time to time. In one case where a day elapsed between training and the first fight, fighting and dominance could only be reobtained by further training.

Here the explanation appears to be that the mice become conditioned to fight any mouse which the observer puts into the pen. After the first unchecked fight the winning mouse is conditioned to chase and and the loser to run away. When these responses are not reinforced by the introduction of a fighting mouse, they tend to die out.

The probability of getting such consistent results by chance is very small. These and consistent preliminary data make it highly probable that the theory of determination of social organization by social behavior is correct in so far as social dominance based on the fighting of male mice is concerned.

J. P. SCOTT

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2 B. Ginsburg and W. C. Allee, *Phys. Zool.*, 15: 485–506, 1942.

SCIENTIFIC APPARATUS AND LABORATORY METHODS

A FLOWMETER FOR USE IN AIR SAMPLING PROCEDURES[1]

RECENTLY developed procedures for quantitative collection of air-borne bacteria and glycol vapors which utilize the Moulton atomizer sampler and the Folin aeration tube bubbler[2, 3, 4] depend upon accurate measurements of the air-flow. Most air flowmeters employ the Venturi or orifice principle by which the change in static pressure of an air stream during or after passage through a constriction is used as an index of the rate of air flow. The latter is defined in terms of unit volume of air per unit of time at standard conditions of atmospheric pressure and room temperature. The calibration of these flowmeters is usually carried out by connecting them in series with a standard instrument (wet gas-meter, spirometer bell, standard Venturi meter, etc.) so that these standard conditions are approximated.

It is not widely appreciated, however, that such flowmeters may give rise to erroneous air flow measurements when these standard conditions are not maintained. Flowmeters, connected downstream to a sampling device possessing high intrinsic resistance to the passage of air (*e.g.*, Moulton atomizer sampler) will give readings exceeding by as much as 70 per cent. the true rate of air-flow.[5] The actual value can be determined only by placing the flowmeter upstream to the sampling apparatus, where it will operate under conditions similar to those employed during calibration. Commercially available orifice flowmeters are usually unsuitable for use on the upstream side of air

1 This investigation was aided in part through the Commission on Air-Borne Infections, Board for the Investigation and Control of Influenza and other Epidemic Diseases in the Army, Preventive Medicine Division, Office of the Surgeon General, U. S. Army.

2 S. Moulton, T. T. Puck and H. M. Lemon, SCIENCE, 97: 51–52, 1943.

3 H. Wise, T. T. Puck and H. M. Stral, *Jour. Biol. Chem.*, 150: 61, 1943.

4 H. M. Lemon, *Proc. Soc. Exper. Biol. Med.* (in press).

5 Downstream from a high resistance a considerable decrease in air pressure and therefore air density must occur; as a result a given mass of air will occupy a correspondingly increased volume. Compared with standard conditions, this air mass under diminished pressure must travel with increased velocity through the orifice if it is to pass through the meter in the same period of time, and hence an erroneously high static pressure difference will be observed.

sampling devices, since they may retain some of the material to be collected. Furthermore, they are expensive and fragile and their design is not adapted for sampling in locations difficult of access, such as air ducts.

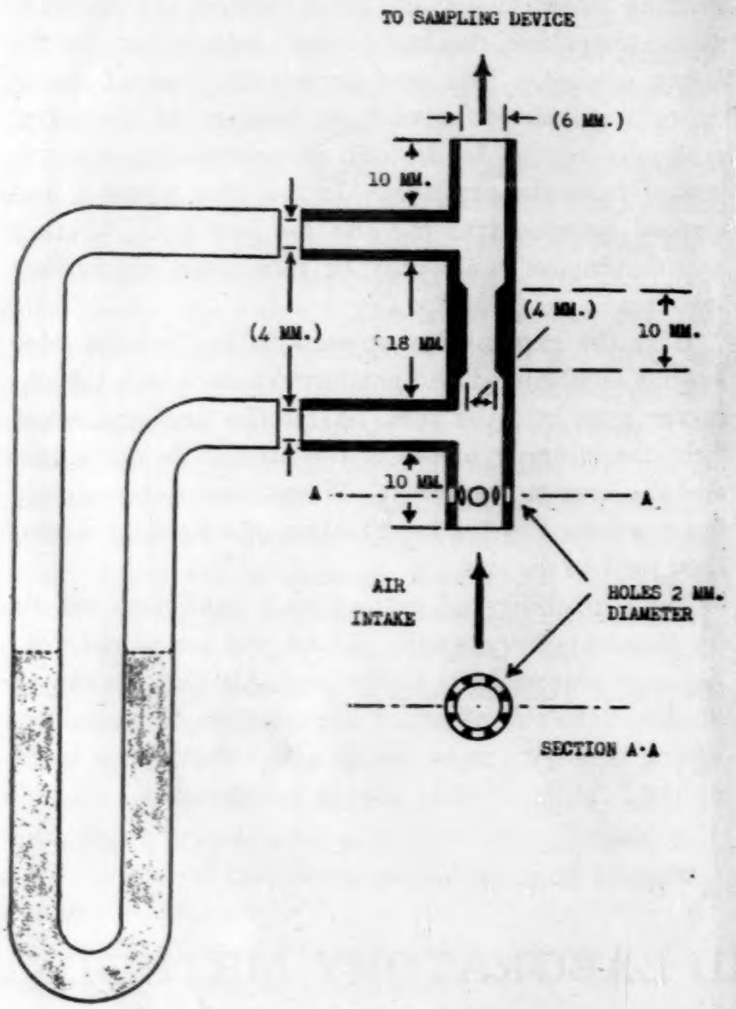

FIG. 1.

To avoid these objections the small flowmeter shown in Fig. 1 was developed. It is designed to be attached to the upstream end of any sampling device. A constricting orifice of 4 mm inside diameter and 10 mm length in a tube of 6 mm inside diameter and 48 mm in length will give a satisfactory change in static pressures for air-flows between 0.33 and 1.30 cu. ft. per minute. This change in static pressure is measured by a glass manometer (4–5 mm inside diameter and 120–150 mm long) filled either with water or a 1 per cent. solution of a suitable detergent with a few drops of phenol red added for coloring; the latter solution inhibits mold growth and improves the wetting of the glass. Graph paper ruled in millimeters backed by a wooden tongue depressor blade and bound to the manometer with transparent cellulose tape provides a simple scale. Any non-corroding metal or chemically inert plastic, such as Plexiglas, may be used in the construction of the flowmeter.

For calibration the flowmeter should be attached upstream to a standard wet-gas meter or a previously calibrated Venturi meter. The calibration curve shown in Fig. 2 has been reproducible within ±5 per cent. by either calibration method.

The eight 2-mm holes drilled 45° apart into the intake end of the meter maintain the static pressure

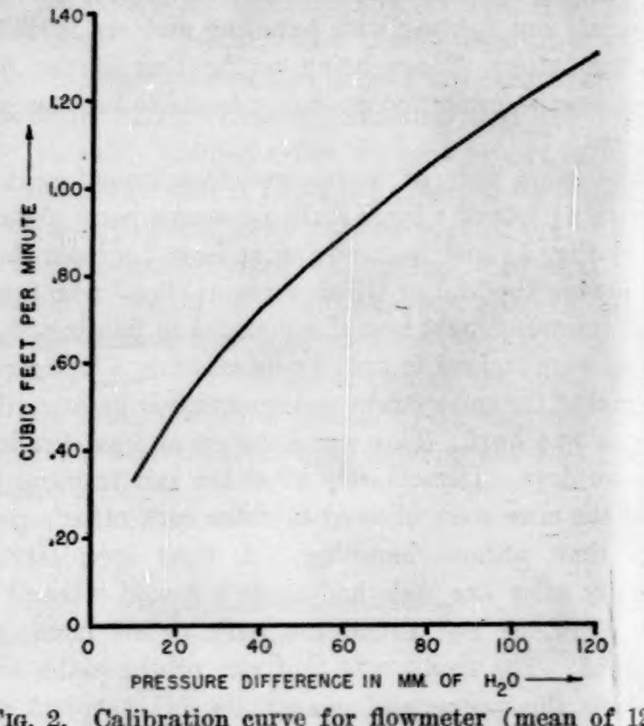

FIG. 2. Calibration curve for flowmeter (mean of 120 determinations) maximum deviation ±5 per cent.

difference within 1–2 mm of water for a given air-flow when the flowmeter is transferred from still to rapidly moving air;[6] without these holes a drop in pressure of 5–10 mm of water occurs.

It is especially designed for accurately measuring air-flows through the Moulton atomizer sampler and Folin aeration tube. Since it is readily cleaned, it does not interfere with determination of air-suspended microorganisms or glycol vapors. It is sufficiently compact and durable so that air samples may be taken in a wide variety of locations.

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[6] Velocities up to 2,500 ft./min.

BOOKS RECEIVED

CLARK, E. P. *Semimicro Quantitative Organic Analysis.* Illustrated. Pp. v + 135. Academic Press, Inc. $2.50.

FEIGL, FRITZ. *Laboratory Manual of Spot Tests.* Translated from the German Manuscript by Ralph E. Oesper. Illustrated. Pp. xii + 276. Academic Press, Inc. $3.90.

SIGERIST, HENRY E. *Civilization and Disease.* Illustrated. Pp. xi + 255. Cornell University Press. $3.75.

SOPER, FRED L., D. BRUCE WILSON, SERVULO LIMA and WALDEMAR SA ANTUNES. *The Organization of Permanent Nation-Wide Anti-Aedes Aegypti Measures in Brazil.* Illustrated. Pp. 137. The Rockefeller Foundation.